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Kanektok River Salmon Monitoring and Assessment, 2012

Annual Report for Project OSM 10-300

USFWS Office of Subsistence Management

Fisheries Resource Monitoring Program

by

Davin V. Taylor

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Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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by

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ABSTRACT

The Kanektok River is the primary salmon spawning drainage in the Quinhagak area and supports subsistence, commercial, and sport fisheries. The Alaska Department of Fish and Game, in cooperation with U.S. Fish and Wildlife Service and the Native Village of Kwinhagak, has operated a resistance board weir on Kanektok River since 2001. The project estimates escapement and provides a platform to collect samples used in estimating age, sex, and length for Chinook *Oncorhynchus tshawytscha*, sockeye *O. nerka*, chum *O. keta*, and coho *O. kisutch* salmon. Additionally, the project monitors the annual Dolly Varden char *Salvelinus malma* run. In 2012, the weir was operational from July 6 through August 15. Weir operations began later than desired and estimates were made to determine passage from June 26 through July 5. Estimates of missed passage of Chinook, sockeye, and chum salmon are included in total escapements. Total escapement through the weir during the 2012 was estimated at 1,568 Chinook, 88,800 sockeye, and 24,173 chum salmon and 20,547 Dolly Varden char. The Chinook and chum salmon escapements were the lowest recorded, while sockeye salmon had the third lowest escapement on record. Chinook salmon age class stratification could not be determined. The sockeye salmon escapement comprised 47% males and was dominated by age-1.3 fish (75%). The chum salmon escapement comprised 52% males and was dominated by age-0.3 fish (56%).

Key words: Chinook, *Oncorhynchus tshawytscha*, chum, *Oncorhynchus keta*, coho, *Oncorhynchus kisutch*, sockeye, *Oncorhynchus nerka*, whitefish *Coregonus* spp. Dolly Varden char, *Salvelinus malma*, rainbow trout *Oncorhynchus mykiss*, Kanektok River, Kuskokwim Area, District W-4, resistance board weir, salmon.

INTRODUCTION

The Kanektok River drainage flows into Kuskokwim Bay near the village of Quinhagak and provides an important annual fishery for subsistence and commercial harvest of Pacific salmon *Oncorhynchus* spp. The Kanektok River weir project, was established in 2001 in an effort to estimate the escapement of Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), chum salmon (*O. keta*) and Dolly Varden char (*Salvelinus malma*), as well as develop a long-term reliable dataset that could be used for management of the fishery. Escapement estimates combined with commercial catch statistics are used to assess daily run strength and provide abundance information that is critical to the management of the commercial salmon fishery in District W-4.

SALMON FISHERIES

Subsistence Fisheries

Subsistence fishing for salmon occurs in the Kanektok River, nearby streams, and Kuskokwim Bay. Salmon caught for subsistence use make important contributions to annual harvests of residents from Quinhagak and nearby communities. The Alaska Department of Fish and Game (ADF&G) has quantified subsistence salmon harvests in the Quinhagak area since 1968, and methods have been consistent since 1988. From 2001 to 2010, annual subsistence harvests have averaged 3,607 Chinook, 1,690 sockeye, 1,517 chum, and 1,611 coho salmon (*O. kisutch*) (Carroll and Hamazaki 2012). There is no estimate of total subsistence harvest of Dolly Varden char from the Kanektok River, but Carroll and Hamazaki (2012) interviewed 87 of 155 households in Quinhagak who reported harvesting 2,399 char from the Kanektok drainage. It is difficult to track non-salmon subsistence harvest among years because the methods have not been consistent, but the importance of char, primarily Dolly Varden char, to the subsistence diet in southwest Alaska is well known (Mark Lisac, USFWS Fisheries Biologist, personal communication). Wolfe et al. (1984) estimated that char accounted for a significant portion of the total subsistence harvested fish in the village of Quinhagak.

Commercial Fishery

Commercial salmon fishing has occurred in the Quinhagak area since before statehood. In 1960, commercial fishing District W-4 was established offshore of Quinhagak in Kuskokwim Bay (Figure 1). Since the inception of District W-4, its northern boundary has been shifted between Weelung Creek and Oyak Creek in response to overcrowding issues and concern over the interception of fish bound for Kuskokwim River. In 2004, the Alaska Board of Fisheries (BOF) extended the northern boundary 3 miles north up the coast from the southern edge of Oyak Creek to the northernmost edge of the mouth of Weelung Creek. The southern boundary is located at the southernmost edge of the mouth of Arolik River. The boundary area extends 3 miles from the coast into Kuskokwim Bay. The District W-4 commercial fishery targets Chinook, sockeye, and coho salmon. Chum and pink (*O. gorbuscha*) salmon are harvested incidentally, with pink salmon being the least commercially valuable species.

Since 1960, commercial salmon harvests in District W-4 ranged from 3,918 to 273,573 salmon, with an historic average of 123,980 salmon. Total harvests have increased since the low years of 2001 and 2002 when market demands and processing capacity were low. The most recent 10-year average harvest (2002–2011) was 191,668 salmon and the most recent 5-year average harvest (2007–2011) was 237,457 salmon. Additional information on the W-4 commercial fishery can be obtained in the 2011 Kuskokwim Area management report (Brazil et al. 2013).

Sport Fisheries

In addition to commercial and subsistence harvest, Kanektok River also supports a popular sport fishery. Sport anglers target Pacific salmon, rainbow trout (*O. mykiss*), Dolly Varden char, and Arctic grayling (*Thymallus arcticus*) from mid-June through the beginning of September each year. Currently, 3 seasonal sport fishing guide camp operations are located on Kanektok River, along with numerous guided and non-guided anglers that float Kanektok River from its headwaters to the village of Quinhagak. Kanektok River fishing effort averages over 5,781 anglers-days annually. The most recent available 5-year average harvest (2007–2011) was 539 Chinook, 1,153 coho, 389 sockeye and 106 chum salmon and 302 Dolly Varden char (Chythlook 2012).

ESCAPEMENT MONITORING

In Alaska, ADF&G is responsible for managing salmon fisheries in a manner consistent with *Sustainable Salmon Fisheries Policy* (5 AAC 07.367). This task requires long-term monitoring projects that reliably measure annual escapement to key spawning systems as well as track temporal and spatial patterns in abundance that influence management decisions.

The Kanektok River is the primary salmon spawning drainage within District W-4. Establishing a viable method for monitoring and assessing salmon escapement in Kanektok River has been problematic (Estensen and Diesigner 2004). The first attempted monitoring project was a counting tower established in 1960 on the lower river near the village of Quinhagak (ADF&G 1960). This tower project was plagued by logistical problems, poor water visibility, and difficulties with species apportionment. In 1961, the tower was relocated to the outlet of Kagati/Pegati Lake (Figure 2) and operated through 1962 (ADF&G 1962). Although successful in providing sockeye salmon escapement information, operation of the tower at this site was discontinued after 1962. Enumeration using hydroacoustic sonar was attempted from 1982 through 1987; however, the use of sonar was deemed unfeasible because of technical obstacles, site limitations, and budget constraints (Huttunen 1988). In 1996, a cooperative effort between the Native Village of Kwinhagak (NVK), United States Fish and Wildlife Service (USFWS), and ADF&G reinitiated a counting tower located 25 km upriver from the mouth of Kanektok River. The counting tower again proved to have limited utility (Fox 1997) despite improvements to the project in 1998 (Menard and Caole 1999). In 1999, resources were redirected toward developing a resistance board weir (Burkey et al. 2001). The weir was operational briefly in 2000, but high water levels, technical limitations, and personnel problems precluded the project from meeting its objectives (Linderman 2000). During operation in 2000, the site was determined unsuitable for a weir because of extensive bank erosion.

In 2001, the weir was relocated approximately 33 km upriver from the original site (Estensen and Diesigner 2003). This relocation required a "Special Use Permit" from the USFWS to operate within a congressionally designated Wilderness Area (Togiak National Wildlife Refuge). The weir was successfully installed and operated in 2001; however, installation was delayed until August 10 because of high water. In 2002, an attempt was made to install the weir just after ice-out in early May, but high water still delayed complete installation until late June. In 2003, crews arrived on-site even earlier and successfully installed the weir during the last week of April, before snowmelt and spring precipitation raised water levels beyond a workable point. Installation and optimal operational start time of the weir was determined to be dependent upon early installation in late April, just after ice-out. When feasible, an early installation strategy had been employed annually from 2003 to 2011. The weir project operated into coho salmon season during 2001 through 2005. Increasing river depth during early fall hindered weir removal in most years. The majority of weir components were removed from the water for the off-season; however, deep water portions of the rail were left in throughout the winter to ease installation the following year. High water in fall of 2005 prevented removal of the weir; components were burdened and buried by debris and gravel and subject to frozen river conditions. Damages from overwintering totaled the weir and prevented operation in 2006. The weir was rebuilt during the 2006 season and was ready for install and operation in 2007. To avoid future high water removal complications and possible overwinter component destruction, ADF&G decided to end monitoring operations in August, after the majority of the sockeye salmon run has passed. For this reason, the weir no longer operates through coho salmon season. Since 1996, the project has continued as a cooperative venture between ADF&G, USFWS Togiak National Wildlife Refuge, USFWS Office of Subsistence Management (OSM), and NVK. The project has provided escapement data representing fish spawning above the weir location. Salmon spawn throughout the Kanektok River drainage and the weir does not account for fish that spawn below the site. Formal escapement goals have not been developed for any species at this weir (Estensen et al. 2009).

Dolly Varden char, although not managed for commercial interest, are an important subsistence resource, and the annual returns of Dolly Varden char into the Kanektok River have been enumerated since 2001 (Taylor and Elison 2012). Dolly Varden char runs are known to be aggregates of mixed stocks, maturities, and a great range of sizes (DeCicco 1992; Whalen 1992; Crane et al. 2004; Lisac 2006, 2007, 2008, 2011). Comparing Dolly Varden char total run estimates at the weir can be misleading for long term monitoring efforts. From 2002 to 2007 Dolly Varden char run monitoring at the Kanektok River weir also included radio telemetry, genetic tissue collection, seining, and sampling to determine length, sex and maturity of the sample. This effort, although discontinued for now, was used to determine the proportion of mature spawning fish in the annual runs of Dolly Varden char and may assist with interpreting long term trends in future years.

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Salmon age, sex, and length (ASL) information has been collected from the weir project since 2001 and from District W-4 commercial harvest since 1969 (Brodersen et al. 2013. Historical summaries of existing ASL information for salmon returning to the Kanektok River can be found in Brodersen et al. 2013. Dolly Varden char sex, length and maturity information had been collected at the weir site from 2002 to 2007 (Lisac 2008), but is no longer being collected.

OBJECTIVES

1. Enumerate the daily passage of Chinook, sockeye, and chum salmon through the Kanektok River weir.
2. Estimate the run timing of Chinook, sockeye, and chum salmon at the Kanektok River weir.
3. Estimate the age, sex, and length composition of the Chinook, sockeye, and chum salmon escapements proportionally such that 95% simultaneous confidence intervals for the age composition have a maximum width of ±10% (α=0.05 and d=0.10).
4. Enumerate Dolly Varden char daily passage and determine run timing through the Kanektok River weir.
5. Record atmospheric and hydrologic conditions at the weir site.

METHODS

SITE DESCRIPTION

The Kanektok River is located in the Togiak National Wildlife Refuge in southwestern Alaska (Figure 2). The Kanektok River watershed drains approximately 2,261 km^2 of surface area and empties into Kuskokwim Bay near the village of Quinhagak (Walsh 2006). The upper portion of the river consists primarily of a single channel flowing through mountainous terrain. The lower portion of the river flows through a broad alluvial plain and is highly braided with many side channels. The surrounding riparian vegetation is composed primarily of cottonwood, willow, and alder and uplands are dominated by tundra. Chinook, sockeye, chum, coho, and pink salmon along with several other anadromous and resident species including Dolly Varden char and rainbow trout spawn in the Kanektok River drainage.

The Kanektok River weir is located approximately 68 km upstream from the mouth at N 59° 46.057, W 161° 03.616. The channel width is approximately 76 m. The water depth during weir operations ranges from approximately 0.3 to 1.8 m. The bottom substrate is primarily cobblestone, gravel, and sand.

RESISTANCE BOARD WEIR

The design, construction, and installation of the Kanektok River resistance board weir largely followed those described in Stewart (2002, 2003) and Tobin (1994). Additional details concerning the resistance board weir components used on Kanektok River are described in Estensen and Diesinger (2004) and Pawluk and Jones (2007).

Two fish passage chutes were installed on the weir, 1 approximately 30 m from the south bank and the other approximately 8 m from the north bank. Gates were attached on both chutes to regulate fish passage. Live traps installed directly upstream of both passage chutes were used to collect fish for ASL sampling. Picket spacing (4.3 cm between pickets) allowed smaller fish, such as pink salmon and other non-salmon species, to pass through the weir between pickets. Downstream migrating fish passing over or through the weir were not enumerated.

Boats passed at a designated boat gate as described in Estensen and Diesigner (2004). Boats with jet-drive engines could pass over the boat gate panels independent of the crew by reducing speed. Rafts could pass downstream by submerging the boat passage panels and drifting over the weir. Boats with propeller-drive engines were uncommon and required being towed upstream across the weir with the assistance of crew members.

ESCAPEMENT MONITORING AND ESTIMATES

To determine salmon escapement past the weir, fish passage counts were made daily during the operational period of the project. Passage counts occurred regularly throughout the day, typically for 1–2 hour periods, beginning in the morning and continuing as late as light permitted. During counting periods, fish passage chute gates were opened allowing fish through the weir. Crew members identified and enumerated all fish by species as they passed upriver through the chutes. Any fish observed in the live trap, returning downstream through the fish passage chutes were excluded from the upstream tally.

Passage missed during inoperable periods or breach events was estimated using the Hierarchical Bayesian Estimation technique (Su et al. 2001). In this, a log-normal distribution run timing model was fitted to log plus 1 transformed daily passage weir counts (ln(daily weir count +1)).

Let y_{it} be the log plus 1 transformed weir count of i^{th} year (1998–2012) and t^{th} day; let y_{it} = ln(daily weir count +1); and assume that y_{it} is a random variable from a normal distribution of mean θ_{it} and standard deviation of all years, σ . Then:

$y_{it} \sim N(\theta_{it}, \sigma^2)$ and, $\theta_{it} = a_i \exp((\ln(t/\mu_i))^2 / b_i)$,

where θ_{it} is modeled to have a log-normal run timing and,

$a_i > 0$, the maximum daily passage of the i^{th} year;

$t \geq 1$, passage date starting June 1st (t=1 is June 1st);

$\mu_i > 0$, mean passage date starting June 1st of the i^{th} year;

$b_i > 0$, days represented by the run period of the i^{th} year.

At upper hierarchical level, annual maximum daily passage (a_i), mean passage date (μ_i), and spread (b_i) were assumed to be normally distributed as,

$$a_i \sim N(a_0, \sigma_a^2); \qquad \mu_i \sim N(\mu_0, \sigma_\mu^2); \qquad b_i \sim N(b_0, \sigma_b^2).$$

Prior distribution of the above parameters was assumed to be non-informative as,

$$a_0 \sim N(5{,}1000) \quad (a_0 > 0)\ ; \qquad \mu_0 \sim N(0.5{,}100) \quad (\mu_0 > 0)\ ; \qquad b_0 \sim N(50{,}10) \quad (b_0 > 0)\ ;$$

$$\sigma_a \sim \text{uniform}(0.1,\ 10{,}000)\ ; \qquad \sigma_b \sim \text{uniform}(0.1,\ 10{,}000)\ ;$$

$$\sigma_\mu \sim \text{uniform}(0.1,\ 10{,}000)\ ; \qquad \sigma \sim \text{uniform}(0.1,\ 10{,}000)\ .$$

Markov-chain Monte Carlo methods (WinBUGS v1.4; Spiegelhalter et al. 1999) were used to generate the joint posterior probability distribution of all unknowns in the model. Simulation was done for 10,000 iterations, with the first 5,000 burn-in period discarded, and samples were taken every 2 iterations. This resulted in 2,500 samples. From those, Bayesian credible intervals (95%) were obtained from the percentiles (2.5 and 97.5) of the marginal posterior distribution. Available historical data limits estimation of missed passage to the dates June 26 through August 15.

AGE, SEX, AND LENGTH SAMPLING AND ESTIMATES

Sample sizes were calculated using Bromaghin (1993) and adjusted for a non-readable scale rate of 20%; such that sample sizes would produce simultaneous 95% confidence interval estimates of age composition ±10% for each age category ($\alpha = 0.05$ and $d = 0.10$). The sample size for Chinook salmon was adjusted for a finite population. Sample sizes of sockeye and chum salmon were increased by a factor of 3 to allow for postseason stratification. The minimum sample size objective for each species was 228 Chinook, 648 sockeye, and 605 chum salmon.

Daily sample objectives were based on a proportional sampling design. Daily sample proportions were 0.04 for Chinook, 0.01 for sockeye, and 0.02 for chum salmon. The proportion estimates were based on the historical lowest total escapements observed at the weir. Therefore, the daily Chinook salmon sample size was 0.04 of the previous day’s passage. When daily sample objectives were not met attempts were made to collect additional samples during the next opportunity. Ultimately, it was up to the crew leader to determine the appropriate sample sizes and schedule based on fish passage patterns and minimum sample size objectives as outlined above.

The weir crew conducted both passive and active sample capture as needed to achieve the desired Chinook, sockeye, and chum salmon sample goals. Passive capture involves blocking upstream passage and leaving the downstream trap gate open, allowing fish to enter and build up in the live trap. Active sampling involved open live trap gates and enumerating all fish passing upstream. Gates are closed when the target species was observed entering the trap. Crew members used a dip net to capture fish and placed them on a partially submerged measurement cradle. Length was measured to the nearest millimeter from mideye to tail fork. Sex was determined by visually examining external morphology such as the development of the kype, roundness of the belly, and the presence or absence of an ovipositor. Scales were removed from the preferred area of the fish (INPFC 1963). A minimum of 3 scales were removed from each Chinook salmon, and 1 scale was removed from each chum and sockeye salmon. Scales were mounted on numbered and labeled gum cards. After sampling, fish were released upstream of the weir. Gum cards and data forms were completed and returned to the Bethel ADF&G office for processing.

ADF&G staff in Bethel and Anchorage processed ASL data and generated data summaries as described by Brodersen et al. 2013. Samples were divided into 3 strata, based on cumulative percent passage. Each stratum was then weighted by the number of fish passing in that stratum to estimate the overall age and sex composition. Age and sex confidence interval bounds were estimated to determine if the desired precision was met for the season estimate. If the desired precision level was met then the season summary was the weighted average age and sex composition estimate of the escapement. If the desired precision level was not met then only the sample age and sex composition was presented.

Ages were reported in the tables using European notation. European notation is composed of 2 numerals separated by a decimal, where the first numeral indicates the number of winters spent in fresh water and the second numeral indicates the number of winters spent in the ocean (Groot and Margolis 1991). Total age is equal to the sum of these 2 numerals plus 1 to account for the single winter of egg incubation in the gravel. Original ASL; gum cards, acetates, and mark–sense forms were archived at the ADF&G office in Anchorage. Computer files were archived by ADF&G in the Anchorage and Bethel offices.

ATMOSPHERIC AND HYDROLOGICAL MONITORING

Atmospheric and hydrologic conditions were recorded daily at 1000 and 1700 hours. Cloud cover was estimated by percent covered and elevation; wind speed was estimated in miles per hour and direction was noted; precipitation was measured in inches per 24 hours; daily air and water temperature were recorded in degrees Celsius. The river gage height was recorded daily and coincided with a benchmark established in 2001, consisting of a three-quarter inch diameter steel rebar driven into the river bed adjacent to the camp. The benchmark was re-established in 2011 and now consists of an aluminum rod placed near the original bench mark. A marked height on the benchmark represents a river stage of 100 cm. The river gage was a steel rule installed near shore in the river and the 100 cm mark was set level with the benchmark to measure relative water level between years.

RESULTS

WEIR OPERATIONS

The Kanektok River weir does not have a target operational date; however, optimal start time is late June. In 2012, the weir was operated from July 6 through August 15. The weir was removed in mid-August, due to the possibility of heavy rainfall that could raise water levels.

Weir operations began late and well after Chinook, sockeye and chum salmon first migrated past the weir site. An estimation based on historical average run timing was used to determine a possible amount of missed passage before the July 6 start. Historical data is available to support an estimation starting from June 26. June 26 through July 5 estimates of missed passage, prior to operation, are included in Chinook, sockeye and chum salmon season totals.

Structural integrity of the weir was maintained for the majority of the season. One breach event occurred resulting from scouring under the rail August 8 through August 15. Missed passage during this breach event was deemed not significant to escapement totals and run timing, no estimate was established for this period.

SALMON ESCAPEMENT

The total Chinook salmon escapement at the weir in 2012 was estimated to be 1,568 fish. Missed passage prior to operations was estimated to be 93 fish (5.6% of total). Based on the operational period and inclusive of passage estimates prior to operation, the median passage date was July 21 and the central 50% of the run occurred between July 11 and July 29 (Table 1).

The total sockeye salmon escapement was estimated to be 88,800 fish. Missed passage prior to operations was estimated to be 19,160 fish (17.7% of total). Based on the operational period and inclusive of passage estimates prior to operation, the median passage date was July 10 and the central 50% of the run occurred between July 6 and July 14 (Table 1).

The total chum salmon escapement was estimated to be 24,173 fish. Missed passage prior to operations was estimated to be 4,057 fish (14.4% of total). Based on the operational period and inclusive of passage estimates prior to operation, the median passage date was July 13 and the central 50% of the run occurred between July 7 and July 25 (Table 1).

Observed passage of coho salmon during operational period was 4,248 fish. The first coho salmon were observed on July 24. Passage upstream continued after weir operations ceased on August 15. The total escapement of coho salmon is unknown. Only the portion of passage that occurred during the operational period was monitored (Table 1).

The total count of pink salmon through the weir was 62,141 fish. Missed passage estimates are not made for pink salmon (Table 2).

Dolly Varden char, whitefish, rainbow trout and grayling were also counted through the weir. Missed passage estimates are not made for these species. A total of 20,547 Dolly Varden char, 39 whitefish, 28 rainbow trout, and 69 grayling were observed passing upstream during project operations. The median passage date for Dolly Varden char occurred on July 24, and the date of peak passage was July 27 (1,677 fish). Dolly Varden char passage through the weir continued through the last day of operation (Table 2).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Escapement

Sample goals were met for Chinook, sockeye, and chum salmon. No scale samples were collected from coho salmon at the weir in 2012. ASL composition objectives were met for sockeye and chum salmon. Sample size of Chinook salmon did not meet a minimum needed to estimate composition.

ASL samples were collected from 59 Chinook salmon at the weir in 2012. Age was determined for 48 (81.3%) of the Chinook salmon sampled. Sample results were insufficient for stratification and a weighted average age composition of escapement could not be determined. Results of processed samples were 13 age-1.2, 18 age-1.3, 16 age-1.4 and 1 age 2.4 fish. Sex composition of sampled fish was 32 male and 16 female. Mean male length of sampled fish was 507 mm for age-1.2, 671 mm for age-1.3, and 808 mm for age-1.4 fish. Mean female length of sampled fish was 483 mm for age-1.2 760 mm for age-1.3 and 829 mm for age-1.4 fish. Overall, male lengths ranged from 407 to 967 mm and female lengths ranged from 483 to 884 mm (Table 3).

ASL samples were collected from 708 sockeye salmon at the weir in 2012. Age was determined for 575 (81.2%) of the sockeye salmon sampled. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±4.5%. Applied to escapement, age-1.3 was the most abundant age class for sockeye salmon (75.4%), followed by age-1.2 (18.3%). Sex composition of sampled fish was 47.2% male and 52.8% female. Mean male length of sampled fish was 536 mm for age-1.2 and 576 mm for age-1.3 fish. Mean female length of sampled fish was 491 mm for age-1.2 and 535 mm for age-1.3 fish. Overall, male lengths ranged from 388 to 648 mm and female lengths ranged from 439 to 604 mm (Table 4).

ASL samples were collected from 391 chum salmon at the weir in 2012. Age was determined for 382 (97.7%) of the chum salmon sampled. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±5.0%. Applied to escapement, age-0.3 was the most abundant age class for chum salmon (56.1%), followed by age-0.4 (38.1%). Sex composition of sampled fish was 52.3% male and 47.7% female. Mean male length of sampled fish was 589 mm for age-0.3 and 610 mm for age-0.4 fish. Mean female length of sampled fish was 557 mm for age-0.3 and 574 mm for age-0.4 fish. Overall, male lengths ranged from 526 to 697 mm and female lengths ranged from 486 to 646 mm (Table 5).

ATMOSPHERIC AND HYDROLOGICAL MONITORING

Atmospheric and hydrological observations were recorded daily from June 21 through August 20. Air temperatures ranged from 4˚ to 25˚ C. Water temperature ranged from 5.5˚ to 12.5˚ C. The Kanektok River weir experienced heavy rain events in 2012, but water level stayed within operable range. Approximately 13.74 cm of rain occurred throughout the entire season. The largest single rain event occurred on July 21 when an accumulation of 1.93 cm fell during this 24-hour period. Water levels at the weir site based on the 100 cm set bench mark ranged from approximately -1 to 55 cm for the recorded period. A recorded level below zero occurs when the water level is below the 100 cm set bench mark (Table 6).

DISCUSSION

WEIR OPERATIONS

Operation of the weir in 2012 was successful and the majority of the Chinook, sockeye, and chum salmon escapement was observed. Total enumeration of coho salmon was not possible because the coho salmon run continued well after the end of operations in 2012. Passage estimates for the August 8 through August 15 breach event were not established. The breach area was small and occurred in an area of low activity. Due to low overall passage, it was determined that missed passage would not have a significant effect on overall run timing results. Historical run timing shows that the majority of fish would have passed prior to the breach event. Unaccounted missed passage could increase total abundance; however, due to historical run timing it was determined to have no significance affect.

The removal of the weir was successful, with the deep water rail and cable section left in place. Rail placed in deep water areas can winter in the substrate with minimal damage and make weir installation easier next season. Removal of all panels and the shallow rail sections prevents component damage from overwintering in the river, as experienced in previous seasons (Jones and Linderman 2006).

ESCAPEMENT MONITORING AND ESTIMATES

The Chinook salmon escapement estimate for 2012 was the lowest escapement among 10 years of collected data (2002–2011; Figure 3; Appendix A). The escapement total amounted to 16% of the 10-year historical average. Low Chinook salmon escapement estimates were also reported for several tributaries in the Kuskokwim Area (T. Elison, Fishery Biologist, ADF&G Division of Commercial Fisheries Anchorage; personal communication). Chinook salmon run timing was slightly earlier than the historical average (Figure 4). An estimate of passage missed before the July 6 start date is included in the escapement total and used in determining run timing. Escapement without missed passage estimates shows little significant difference in run timing.

The sockeye salmon escapement estimate for 2012 was lower than average and the third lowest among collected historical data (2002–2011; Figure 3; Appendix A). Sockeye salmon run timing was earlier than average (Figure 4).

The estimated chum salmon escapement in 2012 was more than two times below the historical average from 2002 through 2011 (Figure 3; Appendix A). Run timing was earlier than any other historical year (2002–2011; Figure 4). The weir results do not account for the large number of chum salmon, perhaps in excess of weir escapements, known to spawn downstream of the weir.

The escapement of coho salmon in 2012 represents the portion of the run enumerated during the weir operation period. (Appendix A). A low escapement count was expected due to counts ending before peak coho salmon migration in September. Median passage date historically occurs in late August and the central 50% of the run occurs between late August and early September (Clark and Linderman 2009).

The observed escapement of Dolly Varden char in 2012 was higher than the 2002 through 2011 average of 16,597 fish but, lower than the previous peak counts of 43,292 fish in 2010 and 26,056 fish in 2009 (Lisac 2011). The observed escapement is considered a minimum count as the weir does not consistently prevent smaller fish (< 420 mm) from passing between pickets (Lisac 2004). No Dolly Varden char sampling occurred and the proportion of mature fish in the count was not estimated in 2012.

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Trapping Chinook salmon for ASL sampling has been problematic. Chinook salmon are generally reluctant to enter the trap when other fish species are present or when the fyke doors on the trap are set to constrict the entrance. Historically, it has been problematic in most years to successfully achieve ASL pulse sampling goals. In 2011, the sampling goals were changed from a pulse to a proportional sampling method to better represent the total escapement. The proportional goal was obtained in 2012; however, the sample size was insufficient for stratification. Proportional estimates were based on the lowest historical escapement observed at the weir. The 2012 escapement was lower than any other historical total, and the preseason sample collection proportion (0.04) did not generate a sample size adequate to estimate the composition of the run.

Sockeye and chum salmon ASL proportion sampling objectives were met in 2012. Previous pulse based sampling minimums were difficult to obtain during the initial third and the tail third of the runs when weekly counts may be less than the sample objectives for each pulse period. Generally, salmon sex and age composition changes slightly over the course of the run.

Distribution of sample collection across the run can better reflect compositional change. In 2011, sockeye and chum salmon sampling goals were also adjusted to proportions. Adjusting sampling goals to reflect a daily collection based on a set proportion of the cumulative passage has alleviated problems encountered from low abundance during the runs.

Sockeye salmon samples were divided into 3 strata, and a weighted total is presented. Sockeye salmon age-1.3 and age-1.2 dominated escapement age class estimates in 2012. The contribution of age-1.3 fish (75.4%) was stronger than the average observed in previous years (53.3%; Table 4 and Figure 5). When compared to 2011, there was a major reduction in the number of age-1.2 fish and an increase in the number of age-1.3 fish (Taylor and Elison 2012).

Chum salmon samples were divided into 3 strata, and a weighted total is presented. Chum salmon age-0.3 was the dominant age class comprising approximately 56% of the weir escapement (Table 5). Historically, the 2 predominant age classes are age-0.3 and age-0.4 fish in odd and even years, respectively (Figure 5). This generalization was not present in 2010, 2011 or 2012. Compared to historical even year results, 2012 age-0.3 fish (56.1%) showed a higher proportional return than average (50.9%) and the proportion of age-0.4 fish (38.1%) was below average (43.8%).

RECOMMENDATIONS

Establishing long-term funding for the project would help provide long-term escapement, run timing, and age, sex, and length data required to better understand productivity of the Kanektok River. Long-term data sets could be used to develop inriver escapement goals based on run reconstruction and spawner-recruit brood table analyses.

Early installation 2009 through 2011 did not prove cost effective and is no longer recommended. Early installation may occur as conditions permit. Monitoring of water level at the weir site should begin in early June each year to assess conditions for installation. The Kanektok River has demonstrated high water level and water flow in May and June, which often leads to substantial delay in installation until July or later depending on the severity and duration of high water conditions. Late season high water conditions call for removal of the weir in mid- to late-August to avoid complications. Operating this project until mid-August allows assessment of the majority of the Chinook, sockeye, and chum salmon and Dolly Varden char returns upstream of the weir. Weir removal is justified when sockeye salmon daily escapement is <1% of cumulative total for 3 consecutive days.

The weir site is located 68 km upstream and from observation, it is thought that a number of fish spawn downstream of the weir. There is not currently a reliable way to determine the spawner proportion below the weir. Conducting a tagging (telemetry) study or including a sonar project on the lower portion of the river may help to determine spawner distribution above and below the weir location.

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TABLES AND FIGURES

Table 1.–Daily and cumulative Chinook, sockeye, chum, and coho salmon passage, Kanektok River weir, 2012.

	Chinook			Sockeye			Chum			Coho	
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.
06/26	3 [a]	3	0	528 [a]	528	1	206 [a]	206	1	0 [b]	0
06/27	4 [a]	7	0	737 [a]	1,265	1	246 [a]	452	2	0 [b]	0
06/28	5 [a]	12	1	948 [a]	2,213	2	293 [a]	745	3	0 [b]	0
06/29	6 [a]	18	1	1,269 [a]	3,482	4	330 [a]	1,075	4	0 [b]	0
06/30	7 [a]	25	2	1,641 [a]	5,123	6	379 [a]	1,454	6	0 [b]	0
07/01	9 [a]	34	2	2,013 [a]	7,136	8	433 [a]	1,887	8	0 [b]	0
07/02	11 [a]	45	3	2,429 [a]	9,565	11	474 [a]	2,361	10	0 [b]	0
07/03	13 [a]	58	4	2,797 [a]	12,362	14	534 [a]	2,895	12	0 [b]	0
07/04	16 [a]	74	5	3,154 [a]	15,516	17	554 [a]	3,449	14	0 [b]	0
07/05	19 [a]	93	6	3,644 [a]	19,160	22	608 [a]	4,057	17	0 [b]	0
07/06	34	127	8	7,565	26,725	30	1,105	5,162	21	0	0
07/07	49	176	11	5,710	32,435	37	891	6,053	25	0	0
07/08	94	270	17	6,124	38,559	43	937	6,990	29	0	0
07/09	19	289	18	3,939	42,498	48	1,130	8,120	34	0	0
07/10	60	349	22	4,165	46,663	53	619	8,739	36	0	0
07/11	81	430	27	5,565	52,228	59	930	9,669	40	0	0
07/12	104	534	34	6,035	58,263	66	1,033	10,702	44	0	0
07/13	39	573	37	4,971	63,234	71	1,362	12,064	50	0	0
07/14	33	606	39	3,306	66,540	75	705	12,769	53	0	0
07/15	18	624	40	2,018	68,558	77	286	13,055	54	0	0
07/16	15	639	41	2,215	70,773	80	292	13,347	55	0	0
07/17	11	650	41	1,552	72,325	81	228	13,575	56	0	0
07/18	24	674	43	1,468	73,793	83	530	14,105	58	0	0
07/19	40	714	46	1,980	75,773	85	780	14,885	62	0	0
07/20	48	762	49	1,838	77,611	87	670	15,555	64	0	0
07/21	62	824	53	1,367	78,978	89	574	16,129	67	0	0
07/22	68	892	57	661	79,639	90	442	16,571	69	0	0
07/23	39	931	59	935	80,574	91	630	17,201	71	0	0

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Table 1.–Page 2 of 2.

Date	Chinook Daily	Chinook Cum	Chinook % passage	Sockeye Daily	Sockeye Cum	Sockeye % passage	Chum Daily	Chum Cum	Chum % passage	Coho Daily	Coho Cum
07/24	43	974	62	895	81,469	92	356	17,557	73	3	3
07/25	28	1,002	64	593	82,062	92	453	18,010	75	13	16
07/26	53	1,055	67	1,119	83,181	94	520	18,530	77	6	22
07/27	28	1,083	69	673	83,854	94	652	19,182	79	14	36
07/28	43	1,126	72	791	84,645	95	413	19,595	81	29	65
07/29	53	1,179	75	750	85,395	96	567	20,162	83	46	111
07/30	48	1,227	78	471	85,866	97	249	20,411	84	52	163
07/31	31	1,258	80	366	86,232	97	201	20,612	85	44	207
08/01	34	1,292	82	356	86,588	98	241	20,853	86	41	248
08/02	31	1,323	84	225	86,813	98	270	21,123	87	60	308
08/03	31	1,354	86	253	87,066	98	323	21,446	89	62	370
08/04	22	1,376	88	248	87,314	98	165	21,611	89	112	482
08/05	27	1,403	89	102	87,416	98	249	21,860	90	63	545
08/06	26	1,429	91	183	87,599	99	316	22,176	92	177	722
08/07	28	1,457	93	319	87,918	99	423	22,599	93	480	1,202
08/08	13 [c]	1,470	94	197 [c]	88,115	99	306 [c]	22,905	95	428 [c]	1,630
08/09	38 [c]	1,508	96	253 [c]	88,368	100	309 [c]	23,214	96	550 [c]	2,180
08/10	17 [c]	1,525	97	147 [c]	88,515	100	269 [c]	23,483	97	439 [c]	2,619
08/11	11 [c]	1,536	98	117 [c]	88,632	100	166 [c]	23,649	98	355 [c]	2,974
08/12	12 [c]	1,548	99	53 [c]	88,685	100	132 [c]	23,781	98	255 [c]	3,229
08/13	5 [c]	1,553	99	33 [c]	88,718	100	130 [c]	23,911	99	323 [c]	3,552
08/14	7 [c]	1,560	99	19 [c]	88,737	100	112 [c]	24,023	99	251 [c]	3,803
08/15	8 [c]	1,568	100	63 [c]	88,800	100	150 [c]	24,173	100	445 [c]	4,248
Total	1,568			88,800			24,173			4,248	
Observed	1,568			88,800			24,173			4,248	
Estimated	93			19,160			4,057			0	
% Observed	94.4			82.3			85.6			100.0	

Note: Missed passage during the breach event was determined to be negligible. The breach was in an area of low fish movement. Shaded areas indicate 80% of the run. Outside boxes indicate the estimated central 50% of passage. Bold boxes indicate the date that the estimated cumulative 50% passage occurred.

[a] The weir was not operational; daily passage was estimated.

[b] The weir was not operational; daily passage was not estimated.

[c] A breach occurred in the weir, daily passage was not estimated.

Table 2.–Daily and cumulative pink salmon, Dolly Varden, whitefish, and rainbow trout passage, Kanektok River weir, 2012.

	Pink Salmon		Dolly Varden		Whitefish		Rainbow Trout		Grayling	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
07/06	13	13	38	38	0	0	1	1	3	3
07/07	11	24	25	63	2	2	0	1	3	6
07/08	4	28	11	74	3	5	0	1	0	6
07/09	18	46	52	126	2	7	0	1	0	6
07/10	11	57	27	153	0	7	4	5	0	6
07/11	20	77	30	183	0	7	0	5	0	6
07/12	3	80	33	216	1	8	2	7	11	17
07/13	12	92	40	256	2	10	0	7	3	20
07/14	7	99	11	267	1	11	0	7	2	22
07/15	6	105	36	303	5	16	1	8	3	25
07/16	30	135	47	350	0	16	0	8	2	27
07/17	22	157	15	365	0	16	0	8	3	30
07/18	32	189	449	814	0	16	0	8	5	35
07/19	147	336	1,057	1,871	0	16	0	8	3	38
07/20	259	595	910	2,781	0	16	0	8	0	38
07/21	240	835	764	3,545	0	16	0	8	3	41
07/22	544	1,379	423	3,968	0	16	0	8	0	41
07/23	1,752	3,131	933	4,901	0	16	1	9	0	41
07/24	1,105	4,236	522	5,423	2	18	0	9	1	42
07/25	1,703	5,939	1,080	6,503	1	19	5	14	0	42
07/26	2,288	8,227	1,553	8,056	1	20	0	14	7	49
07/27	2,801	11,028	1,677	9,733	0	20	1	15	1	50
07/28	3,392	14,420	1,186	10,919	0	20	1	16	0	50
07/29	4,792	19,212	1,249	12,168	0	20	1	17	1	51
07/30	4,935	24,147	984	13,152	1	21	3	20	0	51
07/31	2,618	26,765	173	13,325	0	21	1	21	1	52
08/01	2,638	29,403	551	13,876	0	21	0	21	0	52
08/02	1,958	31,361	370	14,246	0	21	1	22	1	53
08/03	2,615	33,976	336	14,582	0	21	0	22	1	54
08/04	2,784	36,760	382	14,964	0	21	1	23	0	54
08/05	436	37,196	109	15,073	0	21	1	24	2	56
08/06	1,860	39,056	971	16,044	0	21	1	25	2	58
08/07	5,596	44,652	1,405	17,449	0	21	0	25	0	58
08/08	2,998 [a]	47,650	587 [a]	18,036	4 [a]	25	1 [a]	26	4 [a]	62
08/09	2,690 [a]	50,340	675 [a]	18,711	9 [a]	34	0 [a]	26	1 [a]	63
08/10	2,040 [a]	52,380	400 [a]	19,111	0 [a]	34	0 [a]	26	0 [a]	63
08/11	2,238 [a]	54,618	324 [a]	19,435	2 [a]	36	0 [a]	26	3 [a]	66
08/12	1,869 [a]	56,487	202 [a]	19,637	0 [a]	36	0 [a]	26	0 [a]	66
08/13	2,527 [a]	59,014	292 [a]	19,929	1 [a]	37	0 [a]	26	2 [a]	68
08/14	1,622 [a]	60,636	199 [a]	20,128	1 [a]	38	1 [a]	27	1 [a]	69
08/15	1,505 [a]	62,141	419 [a]	20,547	1 [a]	39	1 [a]	28	0 [a]	69
Total	62,141		20,547		39		28		69	

[a] A breach occurred in the weir, daily passage was not estimated.

Table 3.–Chinook salmon age and sex composition and mean length (mm), Kanektok River weir, 2012.

Sample Size	Brood Year / Age Class	2008 1.2 N	2008 1.2 %	2007 1.3 N	2007 1.3 %	2006 1.4 N	2006 1.4 %	2005 2.4 N	2005 2.4 %	Total N	Total %
48	Male	12	25.0	14	29.2	5	10.4	1	2.1	32	66.7
Total [a]	Female	1	2.1	4	8.3	11	22.9	0	0.0	16	33.3
all data combined	Total	13	27.1	18	37.5	16	33.3	1	2.1	48	100.0
no stratification	95% C. I.		–		–		–		–		–
	Male Mean Length	507		671		808		823			
	SE	17.64		9.83		64.90		0.00			
	Range	407–585		542–723		643–967		823–823			
	n	12		14		5		1			
	Female Mean Length	483		760		829		–			
	SE	0.00		44.04		11.40		–			
	Range	483–483		638–832		760–884		–			
	n	1		4		11		–			

[a] Samples were insufficient for stratification based on proportions of cumulative escapement. A weighted total is not available.

Table 4.–Sockeye salmon age and sex composition and mean length (mm), Kanektok River weir, 2012.

Sample Size		Brood Year / Age Class	2008 0.3 N	2008 0.3 %	2008 1.2 N	2008 1.2 %	2007 1.3 N	2007 1.3 %	2007 2.2 N	2007 2.2 %	2006 1.4 N	2006 1.4 %	2006 2.3 N	2006 2.3 %	Total N	Total %
575	Total [a]	Male	0	0.0	7,177	8.1	32,157	36.2	217	0.2	329	0.4	2,006	2.3	41,887	47.2
		Female	1,025	1.2	9,076	10.2	34,806	39.2	211	0.2	112	0.1	1,683	1.9	46,913	52.8
		Total	1,025	1.2	16,253	18.3	66,963	75.4	429	0.5	441	0.5	3,690	4.2	88,800	100.0
		95% CI		1.4		3.9		4.5		0.5		0.5		2.1		0.2
		Male Mean Length	–		536		576		541		534		551			
		SE	–		4.54		2.23		0.00		40.07		6.52			
		Range	0–0		388–606		501–648		512–571		487–605		486–614			
		n	–		58		212		2		3		14			
		Female Mean Length	533		491		535		470		552		539			
		SE	0.70		3.16		2.00		10.00		0.00		4.33			
		Range	516–577		439–582		448–604		460–480		552–552		515–577			
		n	5		62		205		2		1		11			

[a] Based on proportions of cumulative escapement, sample size were sufficient for stratification. A weighted total is presented.

Table 5.–Chum salmon age and sex composition and mean length (mm), Kanektok River weir, 2012.

Sample Size		Brood Year	2008		2007		2006		Total	
		Age Class	0.3		0.4		0.5			
			N	%	N	%	N	%	N	%
382	Weighted [a] Total	Male	7,624	31.5	4,524	18.7	494	2.0	12,643	52.3
		Female	5,925	24.5	4,690	19.4	916	3.8	11,530	47.7
		Total	13,549	56.1	9,214	38.1	1,410	5.8	24,173	100.0
		95% CI		5.0		5.0		2.6		0.1
		Male Mean Length	589		610		614			
		SE	2.61		3.29		22.71			
		Range	526–697		532–696		568–690			
		n	128		71		7			
		Female Mean Length	557		574		577			
		SE	3.01		4.32		7.89			
		Range	486–630		489–646		531–620			
		n	97		67		12			

[a] Based on proportions of cumulative escapement, sample size were sufficient for stratification. A weighted total is presented.

Table 6.–Daily weather and hydrological observations from the Kanektok River weir site, 2012.

Date	Wind (Dir/ Speed)	Precip (cm)	Air Temp. (C)		Water Temp. (C)		Cloud Cover % / altitude	Water level (cm)	
			AM	PM	AM	PM		AM	PM
Jun 21	NW/6	0.00	9	19	7	9	90/1800	55	55
Jun 22	S/1	0.00	17	25	7.5	9	80/5000	54	52
Jun 23	SE/7	0.05	10	10	7.5	7.5	100/1500	52	47
Jun 24	SE/3	0.76	6	6	6.5	8	100/1700	50	52
Jun 25	SE/3	0.56	5	8	5.5	7	100/1500	50	45
Jun 26	SE/2	0.51	5	6	5.5	6.5	100/500	42	40
Jun 27	SE/3	0.13	11	10	6	7	90/1800	37	35
Jun 28	SE/1	0.05	5.5	12	5.5	7	100/1500	32	30
Jun 29	NE/1	trace	7	11.5	5.5	8	100/400	30	27
Jun 30	E/2	0.00	8	10.5	6.5	8	100/1500	26	26
Jul 1	E/2	0.18	12	7	7	7.5	100/200	26	27
Jul 2	SW/1	0.30	7	9	7	8	100/300	27	28
Jul 3	SE/1	0.89	5	6	6	7	100/1200	28	32
Jul 4	NE/2	0.38	5.5	14	6	8	100/1950	31	31
Jul 5	calm	0.08	7	18	6	9	20/4000	30	29
Jul 6	calm	0.33	11	16	7	8.5	80/200	29	29
Jul 7	SW/3	0.08	8	23	7	8	100/100	28	25
Jul 8	NW/3	0.10	9	19.5	8	11	100/600	33	33
Jul 9	calm	trace	7	8	8	8	100/200	33	32
Jul 10	E/2	1.37	6	11	6.5	8.5	100/2000	34	36
Jul 11	calm	0.61	7	10	7	7.5	100/3000	36	36
Jul 12	SE/4	0.25	7	10	7	8	98/1700	38	38
Jul 13	SE/5	trace	8	8	8	8	100/1900	38	38
Jul 14	E/2	0.28	8.5	10	7	7.5	100/1500	40	41
Jul 15	calm	0.81	8	12.5	6.5	8.5	100/1000	45	47
Jul 16	E/3	0.05	8	11	7	8.5	100/2500	45	45
Jul 17	calm	0.00	15	18.5	7	9	none	42	42
Jul 18	W/3	trace	6	14	7.5	9	100/500	39.5	38.5
Jul 19	SW/1	trace	7.5	11	8	10	100/1000	37	35
Jul 20	SW/5	0.08	9	14	8.5	8	100/3000	33	33
Jul 21	calm	1.93	13	12.5	8	9	100/500	37	41
Jul 22	calm	0.66	12	17.5	8.5	10	100/900	44	42
Jul 23	SE/4	trace	10	10	8.5	8.5	98/900	37	37
Jul 24	S/5	0.00	10	11	8	8.5	100/800	35	35
Jul 25	NE/5	0.00	10	12	8	8.5	100/900	32	32
Jul 26	S/1	0.25	8	8.5	8	9	100/700	32	31
Jul 27	SE/2	0.05	7	14	8	9	100/600	29	28
Jul 28	SE/5	0.00	14	13.5	8.5	10	50/5000	28	26

-continued-

Table 6.–Page 2 of 2.

Date	Wind (Dir/ Speed)		Air Temp. (C)		Water Temp. (C)		Cloud Cover % / altitude	Water level (cm)	
			AM	PM	AM	PM		AM	PM
Jul 29	NE/5	trace	7	7	8	8	100/900	26	27
Jul 30	NW/2	0.97	4	7.5	7	7.5	100/600	30	28
Jul 31	NE/2	0.23	5.5	7	7	7	100/2300	26	26
Aug 1	E/2	0.28	7.5	9	7	7.5	100/500	25	25
Aug 2	W/1	0.30	7	11	6.5	7.5	100/500	25	26
Aug 3	SE/5	0.05	6	9	7	7.5	100/2000	25	24
Aug 4	SE/2	0.00	7	10	6.5	7	100/3000	24	23
Aug 5	calm	0.33	9	15	7	9.5	2/5000	22	22
Aug 6	SW/1	trace	6	11	8	10	100/200	20	20
Aug 7	NE/1	trace	7	11	8	8	100/500	19	18
Aug 8	SE/1	0.00	11	18	8	9	100/2000	18	17
Aug 9	calm	0.00	12	19	8	10	10/5000	16	15
Aug 10	calm	0.00	12	11.5	8.5	10	100/3000	14.5	14
Aug 11	SE/3	0.00	15	19	9	12	30/3000	13	13
Aug 12	calm	0.00	17	25	8.5	12	none	11	11
Aug 13	calm	0.00	20	21	9.5	12.5	none	10	9
Aug 14	calm	0.00	16	19	9	12	15/4000	8	8
Aug 15	SE/3	0.00	13	15	10	11.5	100/2000	7	6
Aug 16	SE/5	0.00	10	13.5	9	10	100/2000	6	2
Aug 17	SE/6	0.03	10	11	9	10	100/1900	1	0
Aug 18	SE/10	0.15	9	9	8	9.5	100/1300	-1	0
Aug 19	SE/4	0.25	8	10	8	9	99/1400	1	1
Aug 20	calm	0.41	4	11	7.5	10	100/2000	1	1

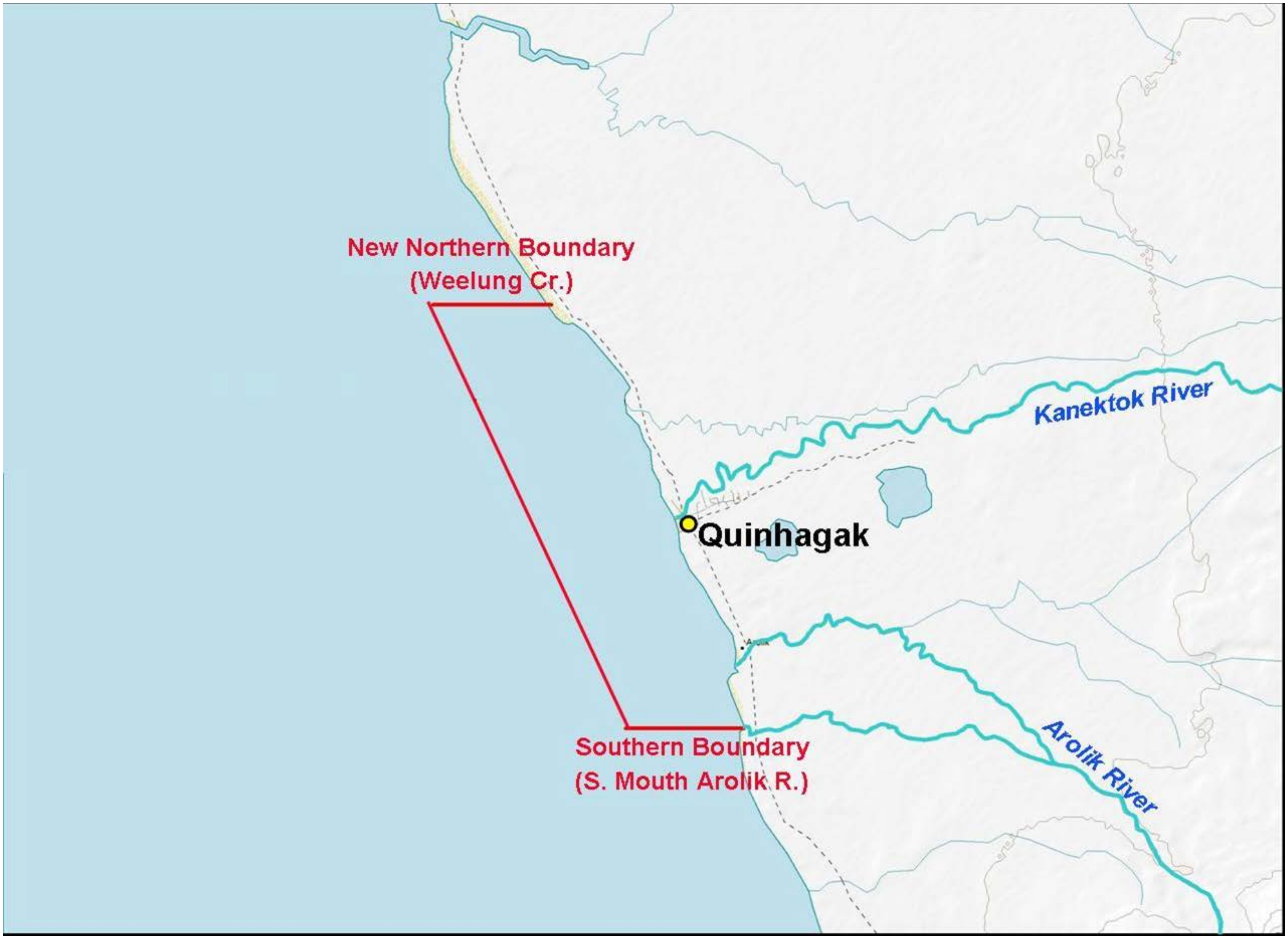


Figure 1.–Commercial Fishing District W-4, Kuskokwim Bay, Alaska, 2012.

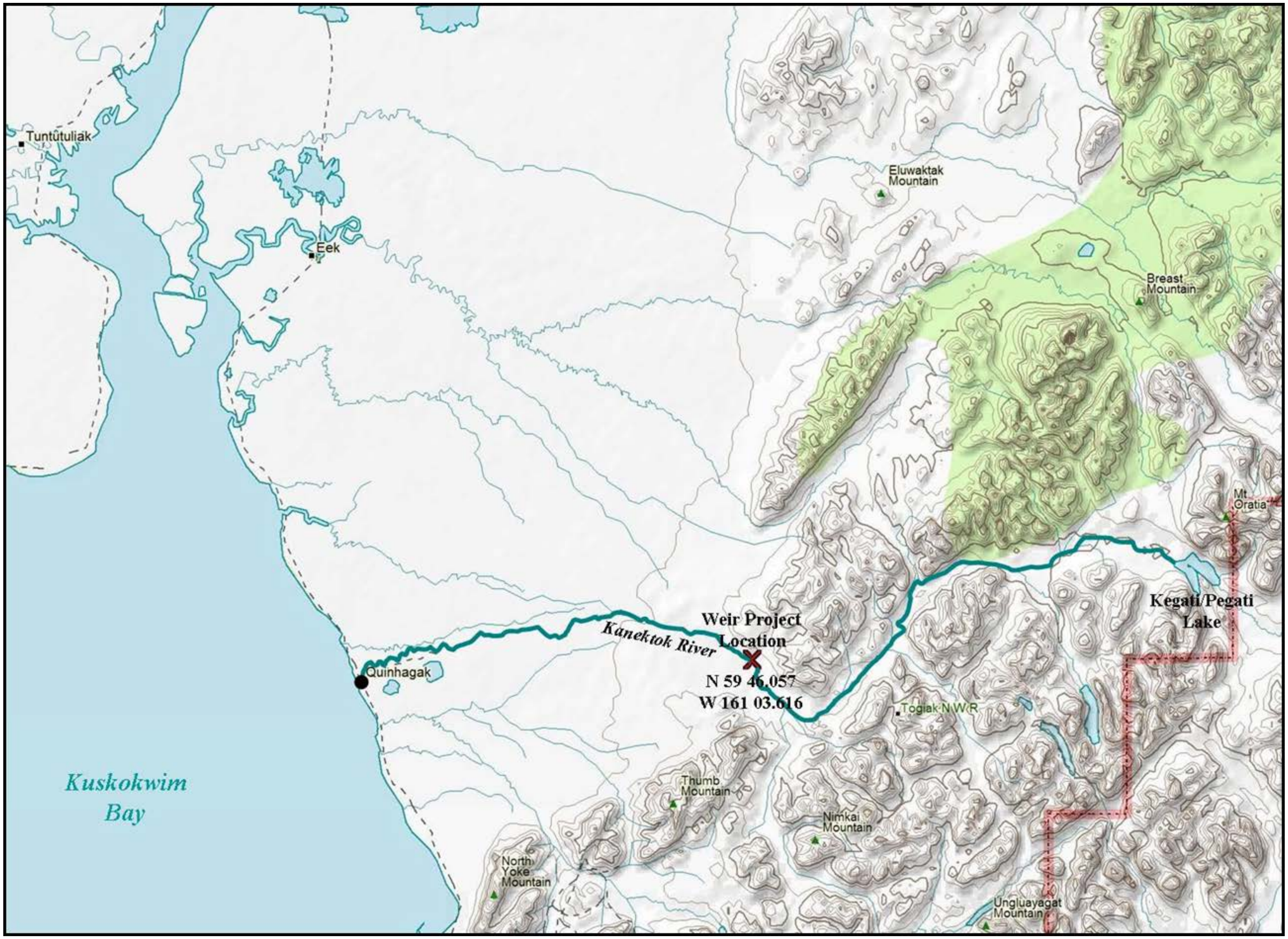


Figure 2.–Kanektok River, Kuskokwim Bay, Alaska.

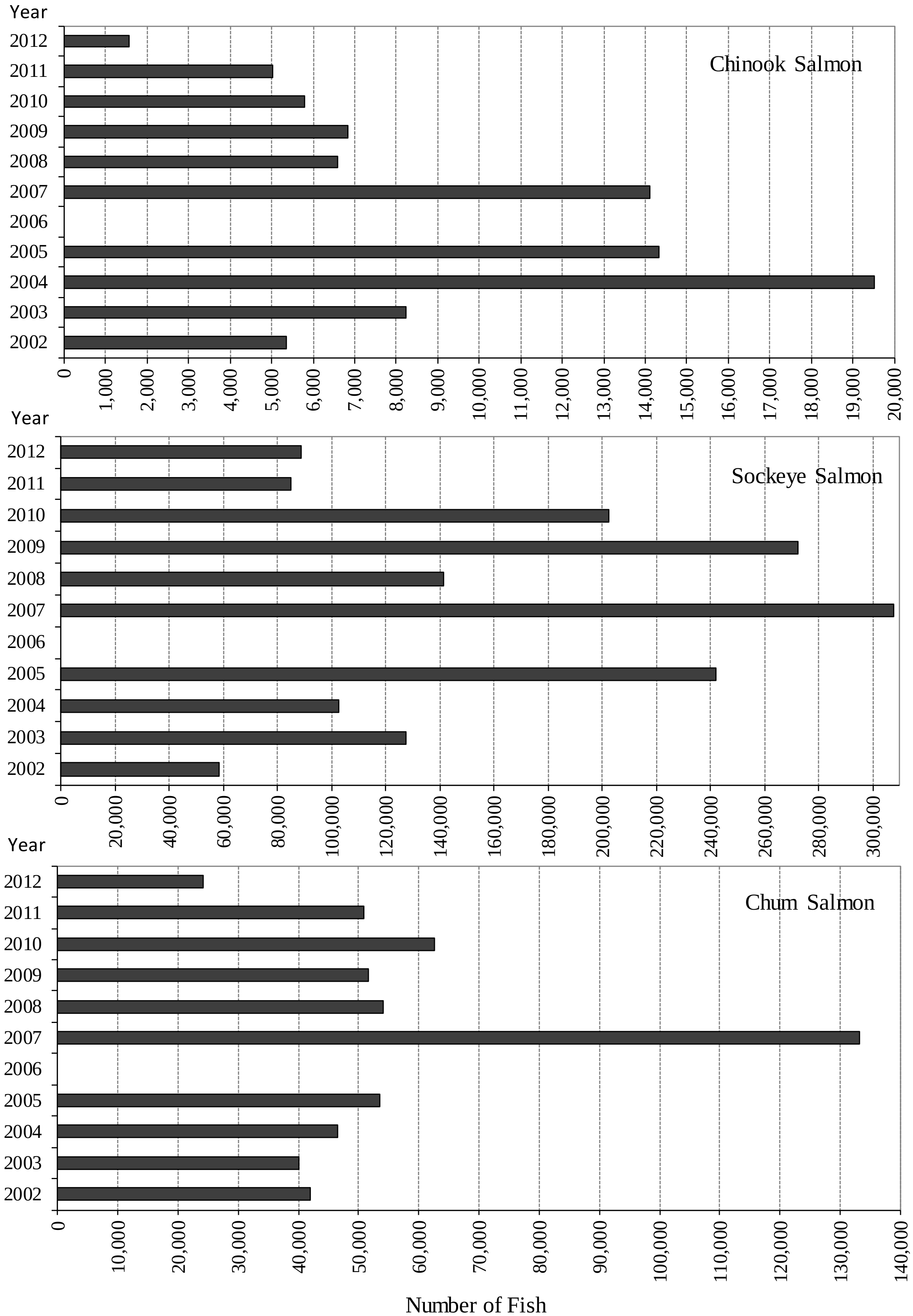
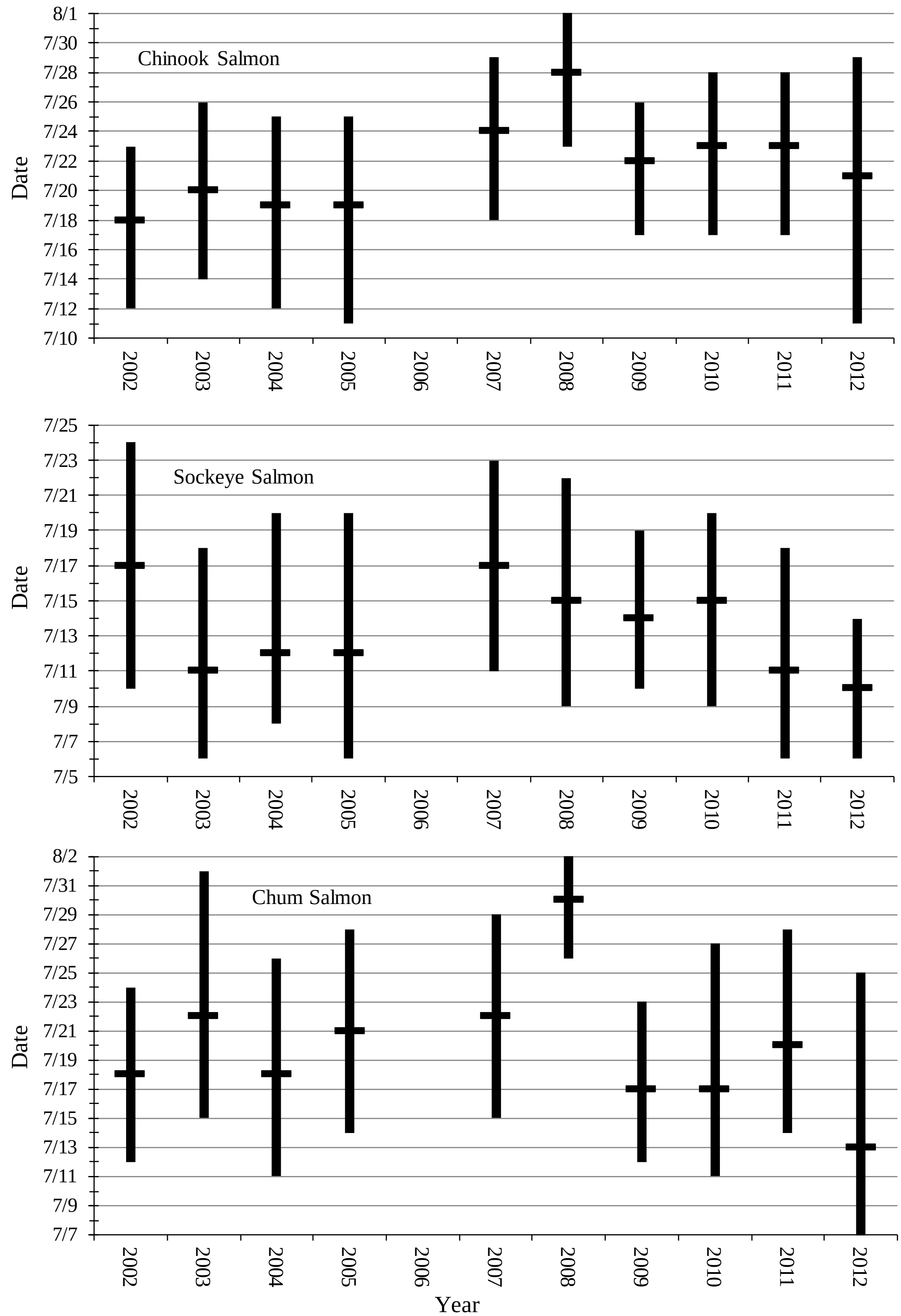
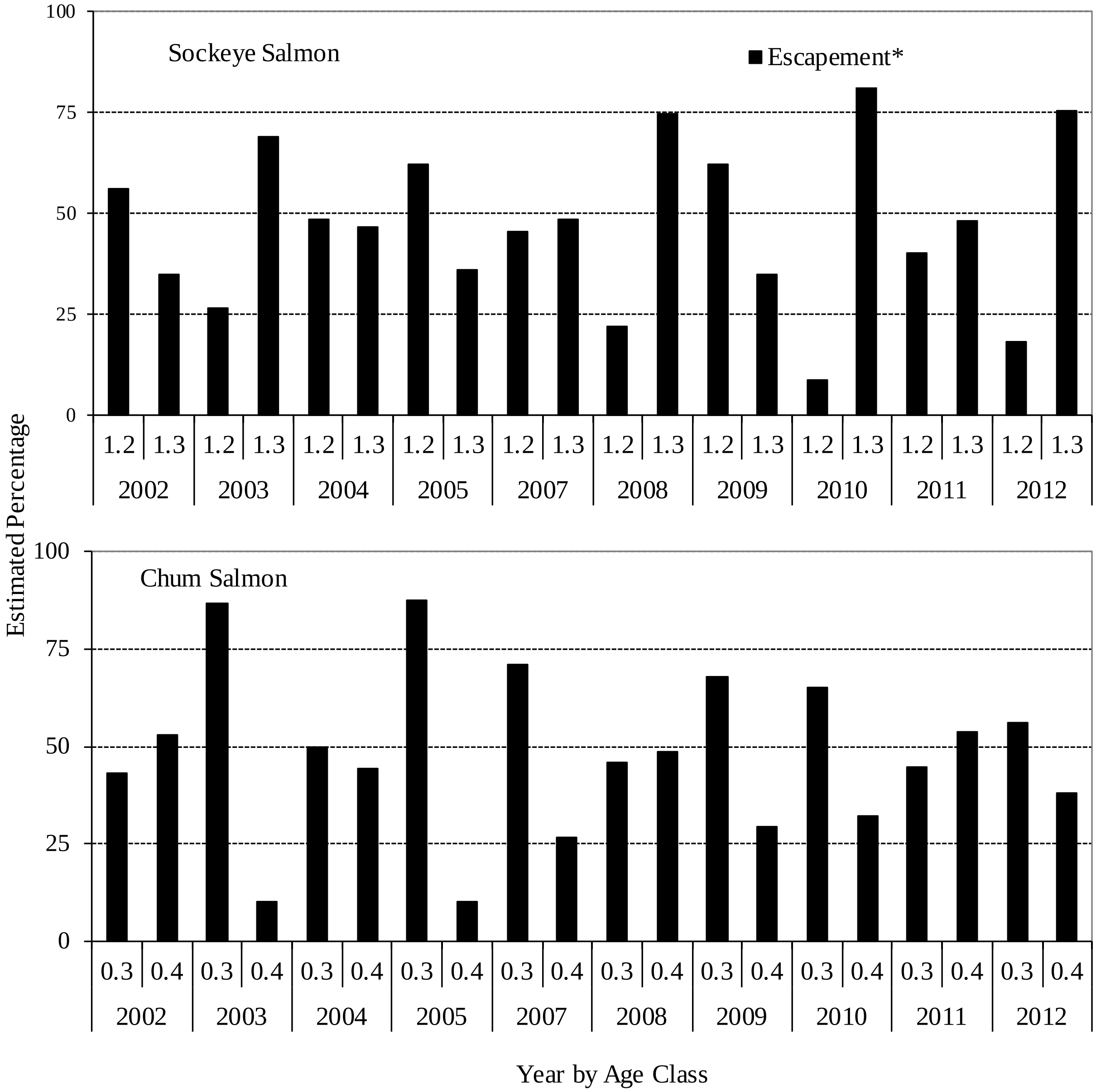


Figure 3.–Historical escapement of Chinook, sockeye, and chum salmon at the Kanektok River weir.



Note: Solid lines represent the dates when the central 50% of the run passed, cross-bars represent the median passage date.

Figure 4.–Annual run timing of Chinook, sockeye and chum salmon based on cumulative percent passage at the Kanektok River weir, 2002–2012.



Note: 2005 escapement age, sex, length data does not represent estimated escapement as it is based on escapement observed and samples collected during weir operations only. 2008 escapement percentages are based on actual samples collected and do not represent total escapement.

Figure 5.–Percentage of age 1.2 and 1.3 sockeye salmon and age 0.3 and 0.4 chum salmon from Kanektok River weir escapement estimates, 2002–2012.

APPENDIX A: HISTORICAL ESCAPEMENT

Appendix A1.–Historical escapement, Kanektok River escapement projects, 1996–2012.

Year	Method	Dates of Operation	Chinook	Sockeye	Chum	Pink [a]	Coho
1996	Counting Tower [b]	July 2–13, 20–25	6,827 [c]	71,637 [c]	70,617 [c]	[c]	[c]
1997	Counting Tower [b]	June 11–August 21	16,731	96,348	51,180	7,872	23,172 [c]
1998	Counting Tower [b]	July 23–August 17	[c]	[c]	[c]	[c]	
1999	Tower/Weir [b]	Not Operational					
2000	Resistance Board Weir [d]	Not Operational					
2001	Resistance Board Weir [e]	August 10–October 3	132 [c]	739 [c]	1,056 [c]	19 [c]	35,650
2002	Resistance Board Weir [e]	July 1–September 20	5,343	58,326	42,009	87,036	24,840
2003	Resistance Board Weir [e]	June 24–September 18	8,231	127,471	40,066	2,443	72,448
2004	Resistance Board Weir [e]	June 29–September 20	19,528	102,867	46,444	98,060	87,828
2005	Resistance Board Weir [e]	July 8–September 8	14,331	242,208	53,580	3,530	26,343
2006	Resistance Board Weir [e]	Not Operational					
2007	Resistance Board Weir [e]	June 19–September 11	14,120	307,750	133,215	3,075	30,471
2008	Resistance Board Weir [e]	July 17–August 21	6,578	141,388	54,024	142,430	24,490
2009	Resistance Board Weir [e]	July 5–August 11	6,841	272,483	51,652	1,246	2,336 [c]
2010	Resistance Board Weir [e]	June 28–August 5	5,800	202,634	62,567	114,074	330 [c]
2011	Resistance Board Weir [e]	June 27–August 15	5,032	84,805	50,908	530	5,779 [c]
2012	Resistance Board Weir [e]	July 6–August 15	1,568	88,800	24,173	62,141	4,248 [c]

[a] Picket spacing of the weir panels allows pink salmon to freely pass through the weir unobserved.
[b] Project located approximately 15 river miles from the mouth of the Kanektok River.
[c] No counts or incomplete counts as the project was not operational during a large portion of species migration.
[d] Project located approximately 20 river miles from the mouth of the Kanektok River.
[e] Project located approximately 42 river miles from the mouth of the Kanektok River.